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ABSTRACT

One component of a project assessing the needs of minority colleges and universities in educational computing, this study focused on computer access and applications at minority institutions as well as their degree programs related to computer science. Four aspects of educational computing at minority institutions were examined: (1) degree programs related to computers and the productivity of these programs; (2) access to computers; (3) use of computers, especially applications in courses; and (4) staff for degree programs related to computer science and costs for computer installations. The fourth inventory from Hamblen's series of inventories of computers in higher education provided the database for these analyses. Findings suggest that the under-representation of certain minorities in the computer professions seems less a problem of access to computing resources than of access to relevant degree programs and faculty members. It is recommended that degree programs in computer science and related fields be initiated and expanded in minority colleges and universities. (MER)

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Access to Computing Resources at Minority Colleges and Universities

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Summary

Colleges and universities responding to the fourth inventory of computers in higher education were designated as minority or non-minority institutions dependent on whether a majority of their student enrollment came from certain racial and national original groups. Summaries of information on computer access and applications at these institutions as well as on their degree programs related to computer science provided a basis for examining the relative needs of minority colleges and universities with regard to academic computing. The major findings were:

- Minority colleges and universities offer only a small number of degree programs in computer science and related fields and, therefore, award a very low number of such degrees each year. The disparity between minority and non-minority institutions in this respect far exceeds their proportional numbers of institutions and their proportional representation in the population. Especially at the baccalaureate and master's degree levels there is a need to initiate and to expand degree programs in computer science and related fields at minority institutions.

- Seventy percent of minority colleges and universities had access to computing resources and sixty-eight percent of non-minority colleges and universities had access to computing resources. Despite their smaller student enrollments and lower degree programs, minority institutions have computers to the same extent that non-minority institutions do.

- Computer installations dedicated to specific applications in administration, instruction, and research show much the same pattern of computer use in both minority and non-minority institutions. There is also a similar pattern in the frequencies with which minority and non-minority institutions offer particular programming languages. Furthermore, comparable percentages of minority and non-minority institutions support remote modes of computing and interactive computing.

- It would appear that students at minority institutions do not receive as much exposure to computers in their academic studies as do students at non-minority institutions. Although differences in student enrollments and in degree programs account for some of the disparity in the total numbers of students using computers in their courses, minority colleges and universities reported only one-fortieth the total number of students with exposure to computers in academic courses reported by non-minority colleges and universities.

- The 105 minority institutions responding to the survey reported a total of 35 full-time faculty members with doctorates in computer science or related degree programs; the 1,707 non-minority institutions reported nearly 1,800 such faculty members. The under-representation of certain minorities in the computer-related professions may be attributed, in part, to the scarcity of appropriate degree programs at minority institutions; and the scarcity of such degree programs may, in turn, be due to a lack of key faculty members.

- Small baccalaureate minority colleges, those with an enrollment of 500-2,499 students, spent more on their computer installations than did comparable non-minority institutions. The greater average expenditure of these minority institutions arose primarily from capital costs for computer hardware and from operating costs from software services. These cost categories would be consistent with acquisition of computer equipment and with expansion of support services, perhaps indicative of recent entry into the computer field.

These findings suggest that the initiation and expansion of degree programs in computer science and in related fields receive the highest priority for attention at minority colleges and universities. Concomitant with this attention to curriculum programs should come concerted efforts to recruit faculty members in these disciplines. The under-representation of certain minorities in the computer professions seems less a problem of access to computing resources than of access to relevant degree programs and faculty members.

Introduction

This report is part of a broader assessment of the needs of minority colleges and universities with respect to educational computing. The focus here is on access to computing resources at minority institutions and on applications of these resources. A comparative approach to the dual problems of access and applications has been taken in examining the status of computing at minority institutions: contrasts will be drawn between minority colleges and universities and non-minority colleges and universities.

A college or university was designated as a minority institution if a majority of its student enrollment represented the following racial and national origin groups: Alaskan Indian, American Indian, Black, Eskimo and Hispanic. Each of these groups has a lower percentage of persons in the sciences than it has in the general population, and in this sense these groups may be viewed as under-represented in the sciences. All other colleges and universities, whether none or half of their students came from these same groups, were designated as non-minority institutions. Thus, the contrasts between the two types of institutions reflect an artificial dichotomy subject to change as enrollment patterns at particular institutions change. And the classification of an institution based on its student body would not necessarily be the same if classification instead depended on minority representation among its faculty.

An existing data base provided information on computer access and use at minority and non-minority institutions. Hamblen's series of inventories of computers in higher education represents the most comprehensive source available on computing in colleges and universities, and the data base from the fourth such inventory[1] was made available for these analyses. The fourth inventory

[1] John W. Hamblen and Thomas B. Baird (Eds.). Fourth Inventory of Computers in U.S. Higher Education 1976-77. Princeton, N.J.: EDUCOM, 1979.

was conducted in June 1977 and reflects the status of computing in higher education at that time. The present report extends the original summaries and analyses by considering minority and non-minority institutions separately and by offering comments on the status of computing according to this distinction.

Purpose

This report examines four aspects of educational computing at minority institutions: (1) degree of programs related to computers and the productivity of these programs; (2) access to computers; (3) use of computers, especially applications in courses; and (4) staff for degree programs related to computer science and costs for computer installations. Degree programs and productivity in computer science and related disciplines depend heavily on an institution's computing resources, and modern computer facilities certainly enhance studies in these fields. Access to computers is essential in some programs, such as data processing in community colleges and computer science in universities, important in other programs, such as mathematics and statistics, and beneficial in all programs given the expanding role of computers in society. Furthermore, faculty and student researchers in the sciences rely heavily on computers in the conduct of their work. The nature of computer uses, whether administrative, instructional, research or some combination, reflects the manner in which academic institutions harnass computer capabilities; and patterns of computer applications in specific courses can reveal particular weaknesses or strengths at minority institutions. Finally, staffing and costs represent two areas where Federal intervention can exert a direct influence on computing resources.

Procedures

The fourth inventory of computers in higher education was a survey of 3,136 colleges and universities in the United States. Each institution

received four forms eliciting information on its computing resources, applications and degree programs. The first form dealt with expenditures on computing, sources of income for computing activities, staffing for computer installations, and computer equipment. The second form covered instructional and research uses of computers by academic fields within the sciences. The third form concentrated on courses and degree programs related to computer science. And the fourth form focused on administrative applications of the computer.

The richness of the full data base resulting from the survey is evident from the original report. The summaries alone run several hundred pages. Since the same summaries for both minority and non-minority institutions constituted the input to this brief examination of computing resources at minority colleges and universities, much of the original detail has been omitted in arriving at an overview. Listings of computers, of specific courses, of administrative applications, and of institutions and installations do not appear here. Moreover, few tables included here retain the elaborate classification system for institutions devised for the inventory. The central objectives for this report were to simplify the extensive data base and to present an overview of computing resources at minority colleges and universities in relation to their non-minority counterparts.

Results and Discussion

Sample. Table 1 shows the number of colleges and universities that receive the fourth inventory of computers in higher education and the number that responded.[2] There were 202 minority institutions in the sample and 105 completed

[2]These figures differ slightly from those reported by Hamblen & Baird since 11 branches of the University of Hawaii system and two other colleges in Hawaii eligible for minority designation were excluded from the sample. These institutions voluntarily declined participation in the belief that their conclusion would distort the results. Furthermore, the classification of three colleges was changed to minority because they had heavy Microesian and Polynesian enrollments. But the change occurred at a late stage in the project so these three colleges were also included among the 2,908 non-minority institutions under the assumption that the three colleges, which had responded only to the first form of the survey, would not distort the overall picture of non-minority institutions.

Total Enrollment	Support	Highest Degree Program	Minority Institutions			Non-minority Institutions		
			Total Sample	Number of Responses	Response Rate (%)	Total Sample	Number of Responses	Response Rate (%)
<500	Public	Associate	1	1	100	51	27	53
		Bachelor's	0	0	-	4	2	50
		Master's	0	0	-	11	6	55
		Doctorate	0	0	-	2	1	50
		Total	1	1	100	68	36	53
	Private	Associate	18	9	50	142	91	64
		Bachelor's	9	6	67	212	111	52
		Master's	0	0	-	137	90	66
		Doctorate	1	1	100	72	47	65
		Total	28	16	57	563	339	60
	Both	Associate	19	10	53	193	118	61
		Bachelor's	9	6	67	216	113	52
		Master's	0	0	-	148	96	65
		Doctorate	1	1	100	74	48	65
		Total	29	17	59	631	375	59
500-2,499	Public	Associate	19	8	42	422	240	57
		Bachelor's	11	7	64	42	26	62
		Master's	6	3	50	33	19	58
		Doctorate	0	0	-	28	18	64
		Total	36	18	50	525	303	58
	Private	Associate	8	5	62	81	43	53
		Bachelor's	42	20	48	411	249	61
		Master's	6	2	33	212	104	49
		Doctorate	2	1	50	42	27	64
		Total	58	28	48	746	423	57
	Both	Associate	27	13	48	503	283	56
		Bachelor's	53	27	51	453	275	61
		Master's	12	5	42	245	123	50
		Doctorate	2	1	50	70	45	64
		Total	94	46	49	1,271	726	57

Table 1-A

Survey Sample and Response Rate

Total Enrollment	Support	Highest Degree Program	Minority Institutions			Non-minority Institutions		
			Total Sample	Number of Responses	Response Rate (%)	Total Sample	Number of Responses	Response Rate (%)
2,500-9,999	Public	Associate	22	9	41	307	159	52
		Bachelor's	6	5	83	29	19	66
		Master's	25	15	60	145	85	59
		Doctorate	2	2	100	41	32	78
		Total	55	31	56	522	295	57
	Private	Associate	3	1	33	5	3	60
		Bachelor's	1	1	100	23	10	43
		Master's	8	5	62	81	55	68
		Doctorate	1	1	100	70	38	54
		Total	13	8	62	179	106	59
	Both	Associate	25	10	40	312	162	52
		Bachelor's	7	6	86	52	29	56
		Master's	33	20	61	226	140	62
		Doctorate	3	3	100	111	70	63
		Total	68	39	57	701	401	57
10,000-19,999	Public	Associate	9	3	33	73	26	36
		Bachelor's	0	0	-	2	1	50
		Master's	0	0	-	37	29	78
		Doctorate	0	0	-	63	47	75
		Total	9	3	33	175	113	65
	Private	Associate	0	0	-	0	0	-
		Bachelor's	0	0	-	0	0	-
		Master's	0	0	-	3	3	100
		Doctorate	0	0	-	18	12	67
		Total	0	0	-	21	15	71
	Both	Associate	9	3	33	73	26	36
		Bachelor's	0	0	-	2	1	50
		Master's	0	0	-	40	32	80
		Doctorate	0	0	-	81	59	73
		Total	9	3	33	196	128	65

Table 1-B

Survey Sample and Response Rate

Enrollment	Support	Highest Degree Program	Minority Institutions			Non-minority Institutions		
			Total Sample	Number of Responses	Response Rate (%)	Total Sample	Number of Responses	Response Rate (%)
<20,000	Public	Associate	1	0	0	22	17	77
		Bachelor's	0	0	-	0	0	-
		Master's	0	0	-	9	3	33
		Doctorate	1	0	0	69	52	75
		Total	2	0	0	100	72	72
	Private	Associate	0	0	-	0	0	-
		Bachelor's	0	0	-	0	0	-
		Master's	0	0	-	0	0	-
		Doctorate	0	0	-	9	5	56
		Total	0	0	-	9	5	56
	Both	Associate	1	0	0	22	17	77
		Bachelor's	0	0	-	0	0	-
		Master's	0	0	-	9	3	33
		Doctorate	1	0	0	78	57	73
		Total	2	0	0	109	77	71
Across Enrollments	Public	Associate	52	21	40	875	479	55
		Bachelor's	17	12	71	77	48	62
		Master's	31	18	58	235	142	60
		Doctorate	3	2	67	203	150	74
		Total	103	53	51	1,390	819	59
	Private	Associate	29	15	52	228	137	60
		Bachelor's	52	27	52	646	370	57
		Master's	14	7	50	433	252	58
		Doctorate	4	3	75	211	129	61
		Total	99	52	53	1,518	888	58
	Both	Associate	81	36	44	1,103	616	56
		Bachelor's	69	39	57	723	418	58
		Master's	45	25	56	668	394	59
		Doctorate	7	5	71	414	279	67
		Total	202	105	52	2,908	1,707	59

Table 1-C

Survey Sample and Response Rate

at least one form in the survey, for a 52% response rate. Of 2,908 non-minority institutions there were 1,707 respondents for a 59% response rate. The difference in response rates stemmed primarily from the lower frequency of replies evident among minority community colleges. With such low response rates it would be inappropriate to cxtrapolate from responding institutions to the total population of colleges and universities, especially in the absence of any independent confirmation of the similarity of respondents and non-respondents. Analyses and observations offered here, therefore, refer just to the sample of institutions for which data were available. Inferences to all minority and non-minority institutions should be made with caution.

Aside from response rates Table 1 reveals some notable imbalances between minority and non-minority institutions. There were 305 non-minority colleges and universities which enrolled 10,000 or more students (i.e., 196 institutions with 10,000-19,999 students and 109 institutions with 20,000 or more students); there were only eleven minority institutions of comparable size and ten of these were community colleges. Furthermore, there were just seven minority universities granting doctorate degrees while there were 414 non-minority universities awarding the same degree. Although there may be acceptable explanations for these discrepancies arising from historical enrollment patterns and efficient use of resources in higher education, they do affect contrasts between minority and non-minority institutions.

Larger enrollments and higher degree programs often mean greater awareness and more widespread use of computing resources. Since a larger number and a larger proportion of non-minority institutions came from these categories, analyses should show minority institutions to be at a disadvantage with respect to computer access and applications. This expectation receives additional weight when the above average response rates from large non-minority

institutions (i.e., a 65% response rate from non-minority institutions with 10,000-19,999 students and a 71% response rate from non-minority institutions with over 19,999 students) and doctoral degree non-minority institutions (i.e., a 67% response rate) are taken into consideration. Indeed, the non-minority institutions with large enrollments tend to be those which offer the doctorate degree.

Degree Programs and Productivity. The numbers of minority and non-minority institutions that have degree programs in computer science and related fields appear in Table 2. Among the 105 minority institutions responding to the survey there were 18 community colleges of 36 responding that had an associate degree program related to computer science, primarily in data processing, 14 colleges with bachelor's degree programs in fields associated with computers, three institutions with master's degree programs, and no doctoral degree programs in any discipline closely linked with computer science. Among the 1,707 non-minority institutions responding to the survey there were 325 associate degree programs, 326 bachelor's degree programs, 145 master's degree programs and 73 doctoral degree programs in computer science and related fields.

The consequences of these marked differences in degree programs become evident in the numbers of students receiving degrees in computer science and related fields from minority and non-minority institutions. Table 3 gives the estimated numbers of graduates by degree level and field for both minority and non-minority institutions. While minority colleges projected 336 recipients of an associate degree in computer science and related fields for the 1977-78 academic year, non-minority colleges projected 5,557 such degrees. And minority respondents projected only 145 bachelor's degrees associated with computer science although there were to be 6,940 bachelor's degrees from non-minority institutions responding to the survey. At the master's degree

Degree Program	Minority Institutions				Non-minority Institutions			
	Number of Degree Programs by Level (1978-79)				Number of Degree Programs by Level (1978-79)			
	Associate	Bachelor's	Master's	Doctorate	Associate	Bachelor's	Master's	Doctorate
Computer Engineering					2	9	7	4
Computer & Information Science					2	5	2	1
Computer Programming	2	0	0	0	35	4	1	0
Computer Science	3	9	3	0	61	190	90	43
Computer Science & Engineering					1	9	9	6
Computer Science Technology					9	3	1	0
Computer Technology					12	1	0	0
Data Processing	11	1	0	0	182	27	2	1
Information & Computer Science					2	5	2	2
Information Science					1	9	3	2
Information Systems	1	2	0	0	4	22	10	5
Mathematical Sciences					0	1	0	0
Systems Analysis					1	1	0	0
Statistics & Computer Science					0	1	1	0
Systems Engineering					0	1	2	0
Systems & Information Science					0	2	1	1
Systems					0	1	2	0
Other	1	2	0	0	13	35	12	8
Total	18	14	3	0	325	326	145	73

Table 2

Science Degree Programs

Degree Program	Minority Institutions Number of Degrees (1977-78) Associate	Bachelor's	Master's	Doctorate	Non-minority Institutions Number of Degrees (1977-78) Associate	Bachelor's	Master's	Doctorate
Computer Engineering					8	137	56	9
Computer & Information Science					10	154	78	14
Computer Programming	56	0	0	0	641	36	0	0
Computer Science	26	84	23	0	735	4,243	1,251	185
Computer Science & Engineering					5	299	187	26
Computer Science Technology					140	65	40	0
Computer Technology					213	7	0	0
Data Processing	209	9	0	0	3,522	625	21	1
Information & Computer Science					25	209	63	4
Information Science					0	90	138	6
Information Systems	5	40	0	0	94	392	131	15
Mathematical Sciences					0	0	19	0
Systems Analysis					5	99	0	0
Statistics & Computer Science					0	50	0	0
Systems Engineering					0	20	19	0
Systems & Information Science					0	70	3	2
Systems Sciences					0	75	4	0
Other	40	12	0	0	159	369	129	15
Total	336	145	23	0	5,557	6,940	2,139	277

Table 3

Science Degree Graduates

level minority institutions projected awarding barely one one-hundredth of the number of degrees to be given at non-minority institutions, 23 versus 2,139. Consistent with the fact that no minority institution reported a doctoral degree program in computer science or related fields, there were no such degrees given from minority institutions in the 1977-78 academic year.

The under-representation of certain racial and national origin groups in the computer professions is understandable given the scarcity of relevant degree programs and the paucity of graduates in computer science and related fields at minority institutions. Especially at the bachelor's and master's levels there seems to be a need to strengthen and expand existing curriculum programs and to initiate new curriculum programs in computer science and related fields at minority institutions if this imbalance is to be alleviated through higher education. Alternatively, non-minority institutions could provide incentives to attract minority graduate degree candidates to these fields of study. The extent of the imbalance may suggest both initiatives.

Access to Computers. The numbers of colleges and universities reporting computer installations in the fourth inventory of computers in higher education appear in Table 4. The access rate given in this table is simply the percentage of institutions in a given classification with computing resources. Despite the expectation that larger non-minority institutions with higher degree programs would lead to a higher access rate among non-minority institutions, the overall access rate for minority institutions was 70% as compared to a 68% access rate for non-minority institutions. Yet the access rate was high relative to the average for larger non-minority institutions with higher degree programs: 92% at institutions with 10,000-19,999 students and 94% at institutions with over 19,999 students; 78% at universities granting the doctoral degree.

Total Enrollment	Support	Highest Degree Program	Minority Institutions			Non-minority Institutions		
			Number of Institutions	Number of Installations*	Access Rate (%)	Number of Institutions	Number of Installations*	Access Rate (%)
<500	Public	Associate	1	0	0	27	9	33
		Bachelor's	0		-	2	0	0
		Master's	0		-	6	4	67
		Doctorate	0		-	1	1	100
		Total	1	0	0	36	14	39
	Private	Associate	9	0	0	91	9	10
		Bachelor's	6	2	33	111	27(28)	24
		Master's	0		-	90	17(19)	19
		Doctorate	1	0	0	47	7	15
		Total	16	2	12	339	60(63)	18
	Both	Associate	10	0	0	118	18	15
		Bachelor's	6	2	33	113	27(28)	24
		Master's	0		-	96	21(23)	22
		Doctorate	1	0	0	48	8	17
		Total	17	2	12	375	74(77)	20
500-2,499	Public	Associate	8	4	50	240	167	70
		Bachelor's	7	7(9)	100	26	24(25)	92
		Master's	3	3	100	19	18(20)	95
		Doctorate	0		-	18	18(23)	100
		Total	18	14(16)	78	303	227(235)	75
	Private	Associate	5	3	60	43	15	35
		Bachelor's	20	12	60	249	181(194)	73
		Master's	2	2(6)	100	104	80(90)	77
		Doctorate	1	1	100	27	20(28)	74
		Total	28	18(22)	64	423	296(327)	70
	Both	Associate	13	7	54	283	182	64
		Bachelor's	27	19(21)	70	275	205(219)	75
		Master's	5	5(9)	100	123	98(110)	80
		Doctorate	1	1	100	45	38(51)	84
		Total	46	32(38)	70	723	523(562)	72

Table 4-A

Access to Computing Resources

*Given as the number of institutions with computer installations accompanied by the total number of installations in parentheses when different.

Total Enrollment	Support	Highest Degree Program	Minority Institutions: Number of Institutions	Minority Institutions: Number of Installations*	Minority Institutions: Access Rate (%)	Non-minority Institutions: Number of Institutions	Non-minority Institutions: Number of Installations*	Non-minority Institutions: Access Rate (%)
2,500-9,999	Public	Associate	9	9	100	159	150(155)	94
		Bachelor's	5	5	100	19	19(21)	100
		Master's	15	15(16)	100	85	82(93)	96
		Doctorate	2	1(2)	50	32	31(43)	97
		Total	31	30(32)	97	295	282(312)	96
	Private	Associate	1	0	0	3	1	33
		Bachelor's	1	1	100	10	9(10)	90
		Master's	5	5	100	55	53(60)	96
		Doctorate	1	1(3)	100	38	35(59)	92
		Total	8	7(9)	87	106	98(130)	92
	Both	Associate	10	9	90	162	151(156)	93
		Bachelor's	6	6	100	29	28(31)	97
		Master's	20	20(21)	100	140	135(153)	96
		Doctorate	3	2(5)	67	70	66(102)	94
		Total	39	37(41)	95	401	380(442)	95
10,000-19,999	Public	Associate	3	3	100	36	35	97
		Bachelor's	0		-	1	1	100
		Master's	0		-	29	27(38)	93
		Doctorate	0		-	47	40(76)	85
		Total	3	3	100	113	103(150)	91
	Private	Associate	0		-	0		-
		Bachelor's	0		-	0		-
		Master's	0		-	3	3	100
		Doctorate	0		-	12	12(33)	100
		Total	0		-	15	15(36)	100
	Both	Associate	3	3	100	36	35	97
		Bachelor's	0		-	1	1	100
		Master's	0		-	32	30(41)	94
		Doctorate	0		-	59	52(109)	88
		Total	3	3	100	128	118(186)	92

Table 4-B

Access to Computing Resources

*Given as the number of institutions with computer installations accompanied by the total number of installations in parentheses when different.

Total Enrollment	Support	Highest Degree Program	Minority Institutions: Number of Institutions	Minority Institutions: Number of Installations*	Minority Institutions: Access Rate (%)	Non-minority Institutions: Number of Institutions	Non-minority Institutions: Number of Installations*	Non-minority Institutions: Access Rate (%)
<20,000	Public	Associate	0		-	17	16(18)	94
		Bachelor's	0		-	0		-
		Master's	0		-	3	3(4)	100
		Doctorate	0		-	52	48(203)	92
		Total	0		-	72	67(225)	93
	Private	Associate	0		-	0		-
		Bachelor's	0		-	0		-
		Master's	0		-	0		-
		Doctorate	0		-	5	5(16)	100
		Total	0		-	5	5(16)	100
	Both	Associate	0		-	17	16(18)	94
		Bachelor's	0		-	0		-
		Master's	0		-	3	3(4)	100
		Doctorate	0		-	57	53(219)	93
		Total	0		-	77	72(241)	94
Across Enrollments	Public	Associate	21	16	76	479	377(384)	79
		Bachelor's	12	12(14)	100	48	44(47)	92
		Master's	18	18(19)	100	142	134(159)	94
		Doctorate	2	1(2)	50	150	138(346)	92
		Total	53	47(51)	89	819	693(936)	85
	Private	Associate	15	3	20	137	25	18
		Bachelor's	27	15	56	370	217(232)	59
		Master's	7	7(11)	100	252	153(172)	61
		Doctorate	3	2(4)	67	129	79(143)	61
		Total	52	27(33)	52	888	474(572)	53
	Both	Associate	36	19	53	616	402(409)	65
		Bachelor's	39	27(29)	69	418	261(279)	62
		Master's	25	25(30)	100	394	287(331)	73
		Doctorate	5	3(6)	60	279	217(489)	78
		Total	105	74(84)	70	1,707	1,167(1,508)	68

Table 4-C

Access to Computing Resources

*Given as the number of institutions with computer installations accompanied by the total number of installations in parentheses when different.

Apparently the computing resources for academic programs in computer science and related fields exist at minority institutions. Other reports[3] may reveal whether the quality of these resources can support academic programs. This report provides further information on the use of computers at minority and non-minority institutions as well as the faculty for academic programs in computer science and the costs of computer installations at minority and non-minority institutions.

Computer Uses and Applications. The number and percent of computer installations devoted to three major categories of usage are given in Table 5. Just over seven percent of the computer installations at both minority and non-minority institutions were reported as devoted to administrative applications. Minority and non-minority institutions reported the same percentage of computer installations reserved for instructional use only, 5.7%. Consistent with their higher degree programs in computer science and related fields, non-minority institutions had higher percentages of computer installations used only for research or just for research and instruction. But the majority of colleges and universities, whether minority or non-minority, used their computers for administrative applications as well as research and instruction. About two-thirds of the computer installations fell in this mixed category of usage.

The consistent pattern of computer uses for minority and non-minority institutions seems to contradict differences already observed in degree programs for computer science and related fields. From the very low numbers of such degree programs at minority colleges and universities it might be expected that there would be either a lower access rate to computing resources or a different

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[3]See Richard M. Jaeger, Academic Computing in Minority Colleges and Universities. Greensboro, N.C.: University of North Carolina at Greensboro, Center for Educational Research and Evaluation, 1979.

Type of Usage	Minority Institutions		Non-minority Institutions	
	Number of Installations	Percent	Number of Installations	Percent
Administration	5	7.1	97	7.8
Research	1	1.4	57	4.6
Instruction	4	5.7	71	5.7
Administration and Research/Instruction	50	71.4	829	66.9
Research and Instruction	3	4.3	124	10.0
Unknown	7	10.0	61	4.9

Table 5

Computer Usage by Installation

pattern of usage at minority institutions than at non-minority institutions. Since the access rates for the two types of institutions were comparable (i.e., 70% at minority institutions and 68% at non-minority institutions), there should be differences evident in the patterns of computer use. There was no obvious difference in these patterns. Two explanations seem plausible: there may be differences in the quality and power of computing resources at minority and non-minority institutions not apparent from the quantitative report of access to computers, or the category including administrative and instructional or research uses of computers may obscure real differences in the allocation of computing resources to each kind of application.

Table 6 and Table 7 show the extent of instructional use of computers in terms of numbers of courses and numbers of students, and these tables suggest much heavier instructional use of computers at non-minority colleges and universities. Table 6 contains data on comparable minority and non-minority institutions, colleges at which the bachelor's degree is the highest degree program in any discipline and in which student enrollment is 500-2,499. Although the ratio of non-minority to minority institutions, computer installations, and courses involving some computer use is approximately 10:1, the ratio of total students exposed to computers is almost 16:1 at these small baccalaureate colleges. The ratio of students with academic exposure to computers across sizes and degree programs is 50:1 for non-minority institutions to minority institutions, as shown in Table 7. Clearly the large enrollments found at some non-minority colleges and universities must contribute to this vast disparity, but it is doubtful that size alone accounts for the difference. Facilitation of student exposure to computers at minority colleges and universities seems an appropriate response to this inequity. Such facilitation should come about naturally from expansion of academic programs in computer science

Academic Field	Minority Institutions[1]		Non-minority Institutions[2]	
	Number of Courses	Number of Students	Number of Courses	Number of Students
Engineering	4	10	124	3,230
Environmental & Life Sciences	9	50	66	2,486
Computer Sciences	29	478	383	9,138
Mathematics & Statistics	28	494	315	8,380
Physical Sciences	22	345	216	3,768
Psychology	4	0	62	1,701
Social Sciences	8	140	130	2,152
Education	1	25	16	798
Business & Commerce	10	252	121	3,857
Other	27	565	44	2,006
Total	142	2,359	1,477	37,516

Table 6

Computers in Classes, Student Instructional Use:
Institutions with Bachelor's Degree as Highest Degree
and Total Enrollment of 500-2,499 Students

[1]Based on 19 institutions reporting 21 computer installations (total sample of 53 institutions with 27 responding to the survey).

[2]Based on 205 institutions reporting 219 computer installations (total sample of 453 institutions with 275 responding to the survey).

Academic Field	Minority Institutions[1]		Non-minority Institutions[2]	
	Number of Courses	Number of Students	Number of Courses	Number of Students
Engineering	141	4,914	7,214	182,938
Environmental and Life Sciences	83	1,557	2,325	68,268
Computer Sciences	264	8,588	8,367	283,443
Mathematics & Statistics	92	2,398	3,618	122,679
Physical Sciences	55	990	2,360	83,043
Psychology	29	115	1,292	46,730
Social Sciences	98	1,266	2,990	84,335
Education	8	58	1,080	31,234
Business & Commerce	111	3,192	5,194	255,466
Other	73	1,742	2,563	84,498
Total	954	24,820	37,003	1,242,634

Table 7

Computers in Classes, Student Instructional Use:
All Institutions

[1]Based on 74 institutions reporting 84 computer installations (total sample of 202 institutions with 105 responding to the survey).

[2]Based on 1,167 institutions reporting 1,508 computer installations (total sample at 2,908 institutions with 1,707 responding to the survey).

and related fields and would not seem to warrant as high a priority for attention as those curriculum programs.

Table 8 shows the number of computer installations supporting various programming languages and certain modes of access. As with the patterns of computer use (see Table 5), there is remarkable similarity in the support of different languages at minority and non-minority institutions. The exceptions to this general pattern are graphics capabilities the PASCAL language, which in turn imply a possible need for higher-level and more diverse support packages at minority institutions. And such support packages would seem a derivative benefit if there were to be an increase in computer science programs at minority institutions accompanied by upgraded computer equipment and computing capabilities.

The numbers of computer installations with interactive access and with remote access also show minority institutions to be similar to non-minority installations. The fact that roughly two-fifths of the computer installations at both types of institutions had interactive computing available for supporting work on computers suggests that all colleges and universities should seek to increase accessibility to their computing resources.

Staff for Degree Programs and Costs for Computer Installations. Figures on the numbers of staff and faculty in degree programs for computer science and related disciplines appear in Table 9. These figures represent the totals for the 105 minority institutions and the 1,707 non-minority institutions which responded to the fourth inventory of computers in higher education. While the disparity in the number of responding institutions and the number of non-minority institutions with large student enrollments explain some of the sheer differences in numbers of staff and faculty at minority and non-minority institutions, these factors do not fully account for the gross imbalances with respect to faculty.

	Minority Institutions		Non-minority Institutions	
	Number of Installations	Percent	Number of Installations	Percent
Programming Languages:				
FORTRAN	60	71.4	1,076	71.4
COBOL	56	66.7	884	58.6
BASIC	49	58.3	821	54.4
RPG	43	51.2	611	40.5
PL/1	20	23.8	384	25.5
Graphics	3	3.6	329	21.8
APL	19	22.6	295	19.6
PASCAL	0	0.0	147	9.7
COURSEWRITER	5	6.0	86	5.7
TUTOR	1	1.2	40	2.7
PLANIT	0	0.0	15	1.0
LOGO	0	0.0	13	.9
Mode of Access:				
Interactive Computing	31	36.9	623	41.3
Remote Computing	29	34.5	486	32.2

Table 8

Programming Languages and Computing Mode

Degree Program Staff*	Minority Institutions	Non-minority Institutions
Staff		
Full-time Staff	117	2,653
Research Assistants (part-time)	7	684
Teaching Assistants (part-time)	46	1,421
Other (part-time)	73	1,886
Total FTE Staff (full-time equivalent)	174	4,491
Faculty		
Computer Science (Ph.D.'s)	12	716
Other (Ph.D.'s)	23	1,075
Joint Appointments	20	702
Other		
Computer Science (Ph.D.'s)	1	67
Other (Ph.D.'s)	4	144

Table 9

Staff and Faculty in Degree Programs
for Computer Science and Related Fields

*Excluding secretarial and clerical support.

Just thirty-five doctoral faculty members at 105 minority colleges and universities held full-time appointments in academic programs related to computer science in contrast to nearly 1,800 such faculty at non-minority institutions. Lack of the appropriate faculty seems to be the major reason for the scarcity of computer science programs at minority institutions, which in turn has led to under-representation of key minorities in the computer professions.

Information pertinent to the place of computer installations in the organizational structure of academic institutions is given in Table 10. A greater percentage of the heads of computer installations at minority institutions report directly to the head of the institution, perhaps indicating the importance associated with computing resources at minority institutions. Those installations reserved for administrative applications tend to come under the chief business officer; those installations devoted to instruction (and research) tend to come under the chief academic officer. But computer installations with other than just administrative applications also come under the chief business officer, suggesting both the costs of computing services and the reliance of institutions on computers for a combination of administrative and other applications.

Average costs for minority and non-minority small baccalaureate colleges are shown in Table 11. Among the computer installations that provided cost figures were 19 minority respondents and 193 non-minority respondents. Minority baccalaureate colleges with 500-2,499 students actually reported spending more on their computer installations than did comparable non-minority colleges. This larger expenditure went to capital costs for hardware and operating costs for software services. These cost categories for higher expenditures would be consistent with new acquisition of computer equipment and

Supervisor for Head of Installation Computer	Minority Institutions		Non-minority Institutions	
	Number of Installations	Percent	Number of Installations	Percent
Head, Institution or Campus	21	30.0	236	19.0
Head, Computer Facilities	3	4.3	44	3.6
Head, Research	2	2.9	28	2.3
Chief Academic Officer	11	15.7	218	17.6
Chief Business Officer	14	20.0	326	26.3
Business Officer (other)	0	0.0	4	.3
Dean, Engineering	1	1.4	30	2.4
Dean (other)	1	1.4	96	7.7
Department Chair	6	8.6	84	6.8
Other	2	2.9	92	7.4
Unknown	9	12.9	81	6.5

Table 10

Organizational Structure
for Computer Installations

	Minority Institutions[1]		Non-minority Institutions[2]	
	Number of Respondents (Installations)	Installation Average (1976-77)	Number of Respondents (Installations)	Installation Average (1976-77)
Capital Costs				
Hardware	9	$49,111	104	$31,702
Software	6	6,167	45	6,022
Buildings & Furnishings	10	11,900	47	10,894
Operating Costs				
Staff	17	33,000	145	33,131
Hardware (lease)	13	24,538	111	21,757
Software Services	5	15,300	43	7,907
Other	14	13,929	139	13,892
Total Costs Capital and Operating	19	$92,053	193	$72,953
Sources of Income				
Institution	18	$67,222	182	$59,231
State	0	--	3	56,333
Federal	7	52,143	23	64,917
Total	19	$82,947	189	$71,825

Table 11

Computing Expenditures and Income:
Institutions with Bachelor's Degree as Highest Degree
and Total Enrollment of 500-2,499 Students

[1]Based on 19 institutions reporting 21 computer installations (total sample of 53 institutions with 23 responding to the survey).

[2]Based on 205 institutions reporting 219 computer installations (total sample of 453 institutions with 275 responding to the survey).

with expansion of available software. So the higher costs of computer installations at these minority institutions probably reflects recent entry into the computer field rather than a higher level of sustained fiscal support.

Conclusions

The percentage of minority colleges and universities with access to computing resources is nearly the same as that for non-minority colleges and universities. Moreover, the pattern of academic computer installations dedicated to specific applications in administration, instruction, or research was quite similar for minority and for non-minority institutions. And computer installations for minority and non-minority institutions tended to support much the same set of programming languages. Small baccalaureate minority colleges even spent more on their computer installations than did comparable non-minority colleges. The problem of under-representation of minority groups in the computer professions appears not to be one of hardware or computing resources but of persons.

Faculty members with doctorate degrees in computer science or related fields were a very scarce resource at minority colleges and universities. The scarcity of such faculty was reflected by the low numbers of degree programs in computer science and related fields and by the low numbers of students awarded these degrees at minority institutions. If the imbalance of minority representation in employment positions in the computer field is to be addressed through concerted attention, that attention should be focused on relevant curriculum programs and faculty members at minority colleges and universities.